

Water

P.E.I.'s MOST PRECIOUS RESOURCE

**BRUDENELL - CARDIGAN RIVERS COMPLEX
WATERSHED ACTIVITIES**



SURFACE WATER PROGRAM

MARCH 1990

**THE CANADA—PRINCE EDWARD ISLAND
WATER MANAGEMENT AGREEMENT**



Environment
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Canada



Prince Edward Island
Department of the Environment

BRUDENELL - CARDIGAN RIVERS COMPLEX WATERSHED ACTIVITIES

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Environment Canada
Inland Waters Directorate
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P.E.I. Department of the Environment
Fish and Wildlife Branch

SURFACE WATER PROGRAM

MARCH 1990

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PREFACE

This report is one of a series produced as a result of the Canada - Prince Edward Island Water Management Agreement. The work was performed as part of the Watershed Inventory Project under the Surface Water Program.

It was initiated in order to gain a better understanding of the activities which may impact on the quality and quantity of surface waters drained by the Brudenell and Cardigan Rivers.

The report is intended to be used in conjunction with the report entitled "Activities Affecting Surface Water Resources - A General Overview" and the book of "Brudenell - Cardigan Rivers Watershed Complex Inventory Maps" which is maintained on file at Inland Waters Directorate, Environment Canada in Dartmouth, Nova Scotia. All references to maps in this report are to the atlas.

Mapping is performed on the 1:50,000 N.T.S. topographical series using the Universal Transverse Mercator (U.T.M.) grid system to the nearest one hundred (100) metres for point data. Non-point (polygon) data is also mapped where applicable. The data is available on diskette and is easily transferable to Geographical Information System (G.I.S.) thereby providing an opportunity to update and manipulate the data.

ACKNOWLEDGEMENTS

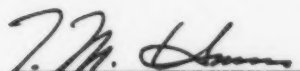
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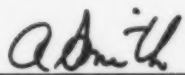

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1.0 INTRODUCTION

In November 1987, the Canada - Prince Edward Island Water Management Agreement was signed. The Agreement focuses upon several areas including groundwater contamination, surface water degradation and estuarine eutrophication. Of these, the Watershed Inventory Project, as part of the Surface Water Program, has been designed to identify current and future users of surface water and to document resource conflicts within twelve watersheds across the province. The Brudenell - Cardigan Rivers Watershed Complex (Figure 1.1) was identified as an area of study for the project.

2.0 GENERAL CHARACTERISTICS OF THE BRUDENELL - CARDIGAN RIVERS WATERSHED COMPLEX

2.1 Description

The Brudenell - Cardigan Rivers Watershed Complex is located in the eastern part of Kings County, P.E.I. The Brudenell and Cardigan Rivers each drain a number of lesser tributaries which then empty into Georgetown Harbour and Cardigan Bay, respectively. The Harbour and Bay both open to the Northumberland Strait.

The several glaciers which at one time covered Prince Edward Island have caused a gently undulating terrain across much of the province. Average elevation across the province is less than sixty-one (61) metres above sea level. The watershed encompasses a rolling section of the Island where maximum elevations do not exceed seventy-seven (77) metres.

The area is largely rural with villages and farms located throughout. As is the case with the Island as a whole, the watershed is traversed by an extensive network of roads. Many are unpaved and are not kept open during the winter months.

2.2 Physiography

The Brudenell - Cardigan Rivers Watershed Complex drains a land base of about one hundred and fifty-three square kilometres (153.04 km²) through approximately one hundred and thirty-two kilometres (132.40 km) of streams and rivers. A physiographic comparison between Prince Edward Island and the Brudenell - Cardigan Rivers Watershed Complex (Figure 2.1) reveals that watershed lands are half covered by trees (50.12%). The Brudenell River subwatershed consists of land that is about fifty-three percent (52.59%) cleared while the Cardigan River subwatershed is much less cleared at approximately twenty-eight percent (27.99%), (Taylor, 1988).

2.3 Soils

Prince Edward Island's podzol soils, formed mainly from

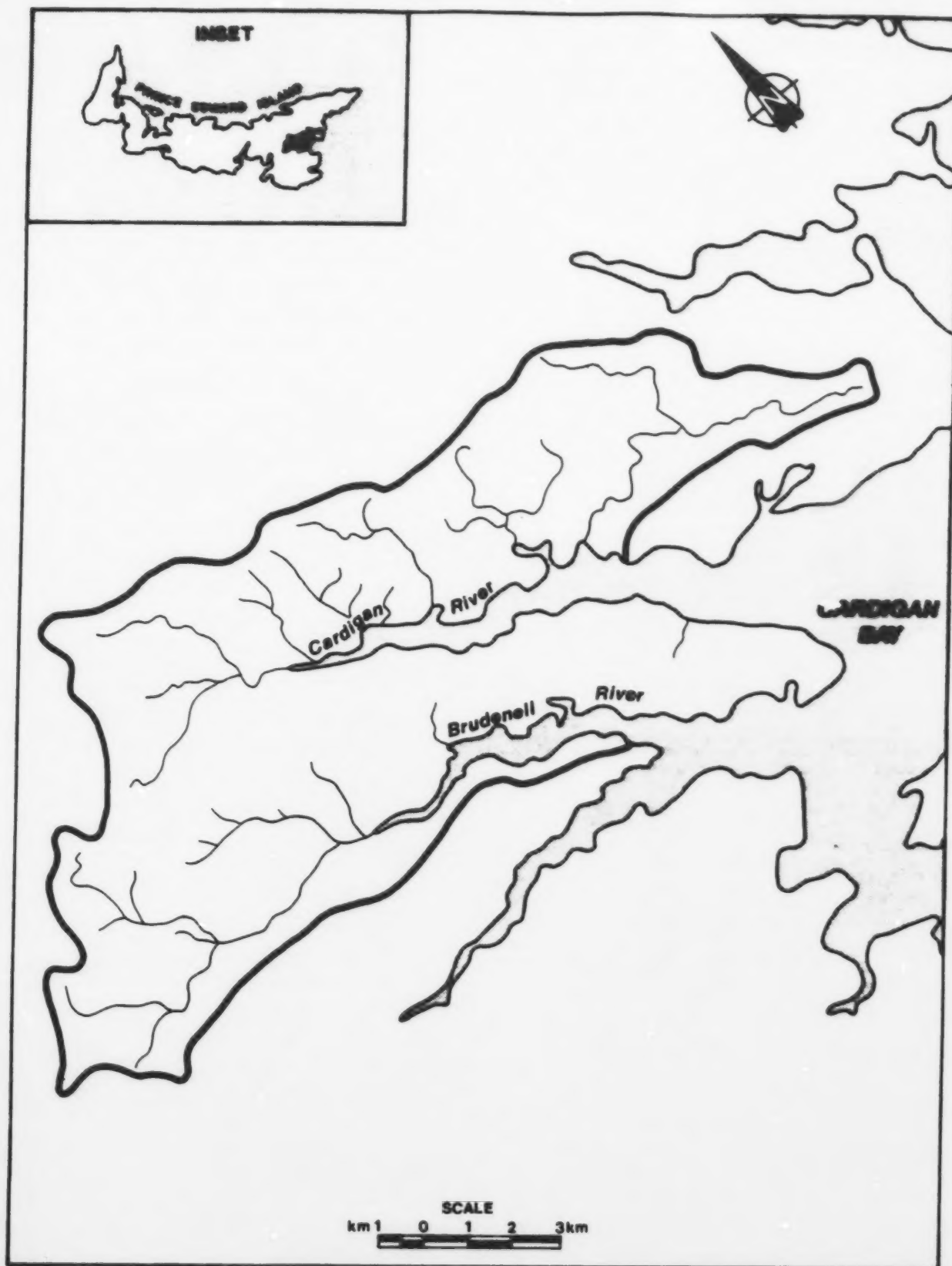
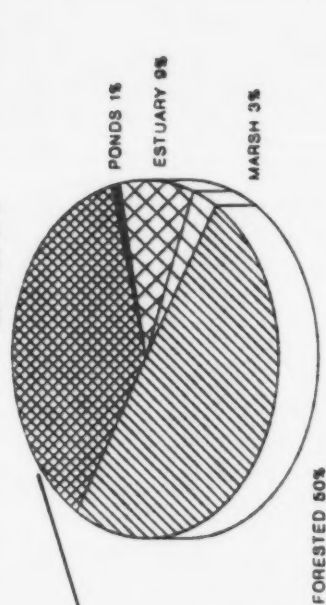


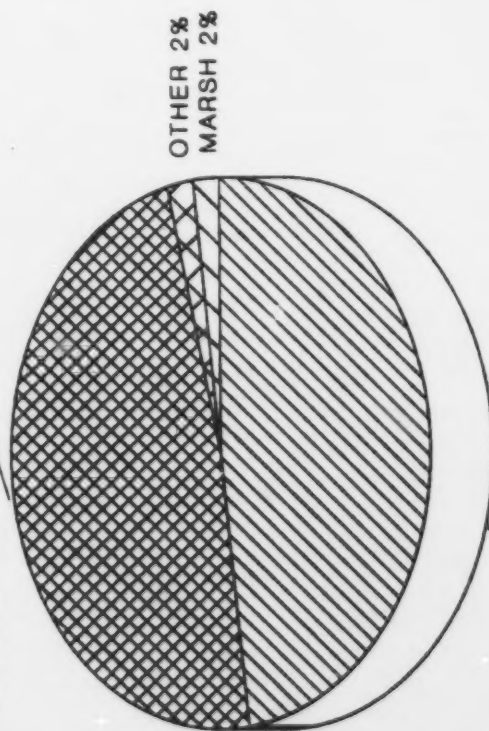
Figure 1.1 Brudenell — Cardigan Rivers Watershed Complex

BRUDENELL - CARDIGAN RIVERS WATERSHED



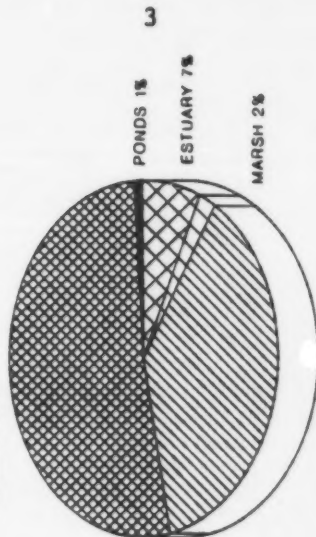
PRINCE EDWARD ISLAND

CLEARED 48%



BRUDENELL RIVER

CLEARED 52%



CARDIGAN RIVER

CLEARED 28%

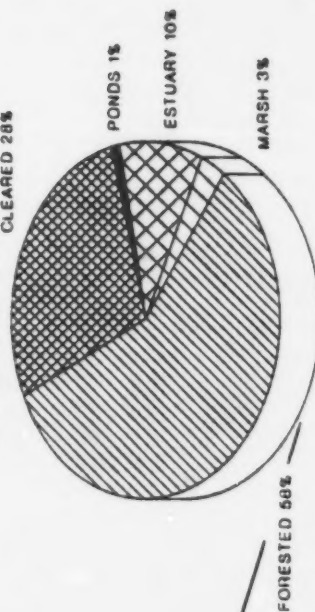


Figure 2.1 Comparison of Physiography Between Prince Edward Island and the Brudenell - Cardigan Rivers Watershed Complex

the weathering of sandstone and the deposition of glacial till, are generally stone-free, sandy and permeable. The Brudenell - Cardigan Rivers Watershed Complex is composed of varying amounts of Class 0, 2S, 3S, 4S, 4^{sw}, 5^{sw}, 5W, 7I, 7S, 7T and 7^{sw} soils. Approximately sixty-five percent (65%) of the soils within the watershed are Class 2, fifteen percent (15%) Class 3, ten percent (10%) Class 4, five percent (5%) Class 5 while the remainder is five percent (5%) Class 0 and Class 7, combined (Canada Land Inventory, 1968).

3.0 AGRICULTURAL OPERATIONS

Agriculture forms a major part of Prince Edward Island's economy and the Brudenell - Cardigan Rivers Watershed Complex's terrain is generally well-suited for crop production. The main farming activities center around the production of livestock (Maps 11L/1 and 11L/2), tobacco, grain, potatoes, and fodder for livestock.

3.1 Dairy Operations

There are nine dairy operations located in the watershed (Figure 3.1) each containing thirty (30) or more head (30 milkers and 30 feeders) of cattle (Younie, 1989).

3.2 Beef Operations

Four beef cattle operations (Figure 3.1) with fifty (50) or more head (50 cattle plus 50 feeders) are present. Two are large herds each containing over two hundred head of cattle (Younie, 1989).

3.3 Hog Operations

There are eight hog operations (Figure 3.1) located within the watershed's boundaries. Each has an annual production of eight hundred (800) or more animals (Younie, 1989). Since hogs are normally housed indoors the only threats to surface water quality are as a result of the improper storage and disposal of manure (refer to section 11.2.1).

3.4 Fur Ranches

The two major fur ranches (Figure 3.1) located in the watershed each contain foxes (Younie, 1989).

3.5 Stock Watering

Most livestock on Prince Edward Island are watered using groundwater piped into troughs (Murphy, S., 1988). However, there have been several instances noted in which animals were observed drinking from streams traversing the pastures (refer to Section 11.2). This leads to destabilization of the

LIVESTOCK OPERATIONS BRUDENELL - CARDIGAN RIVERS WATERSHED

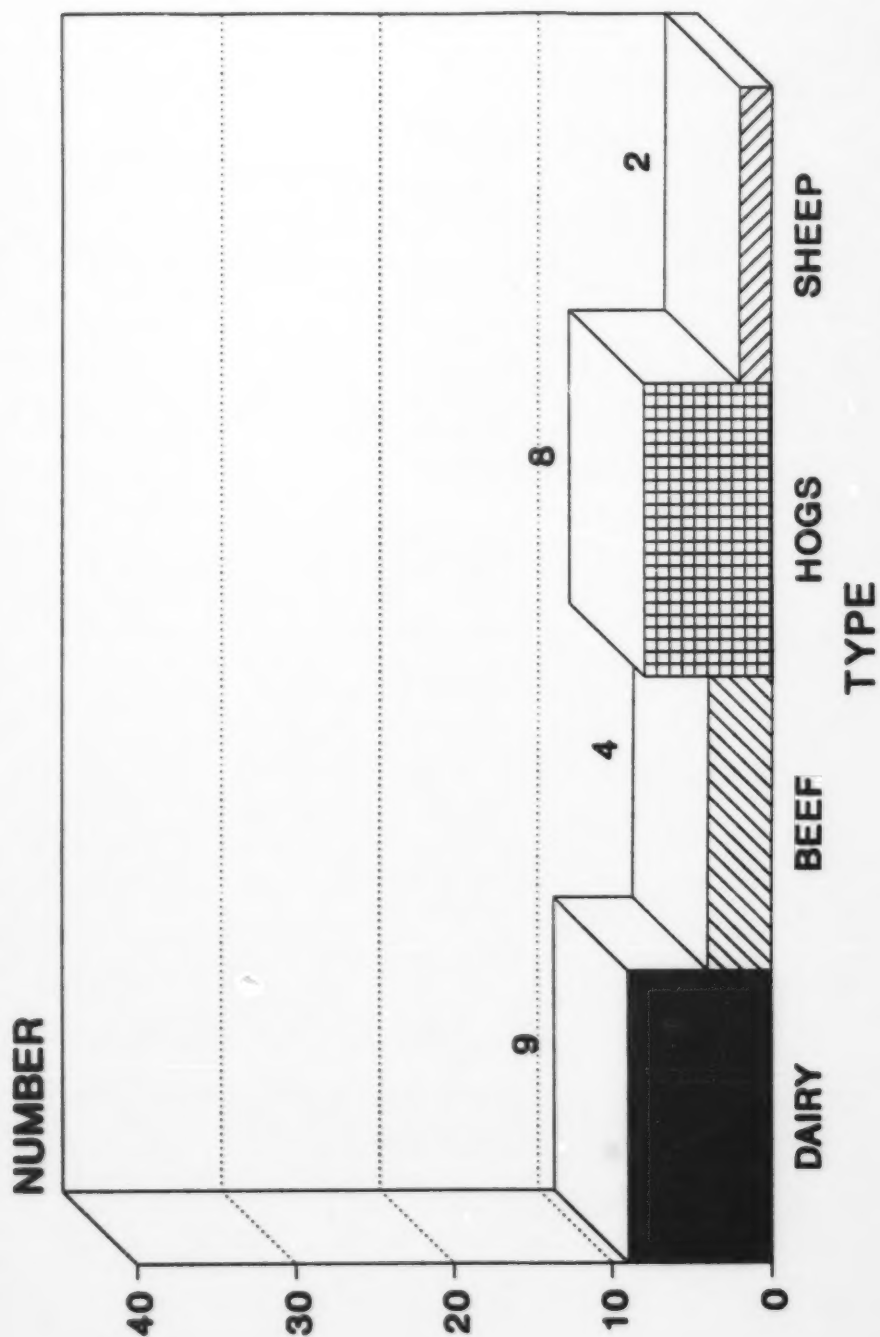


Figure 3.1 Livestock Operations Within The Brudenell — Cardigan Rivers Watershed Complex

stream banks, siltation and bacterial contamination of the water.

3.6 Irrigation

The Prince Edward Island Department of Agriculture does not keep specific records on irrigation occurring within the province. Water used for irrigation generally comes from a surface water source such as a farm pond or stream. In unusually dry years such as 1987, there are probably more farmers than usual who have to irrigate their crops (Clough, 1988). This activity may have an effect on the amount of water available for users downstream of the withdrawal location. Therefore, a monitoring system should be in place so as to regulate the availability of the resource.

3.7 Dead Stock Burial

There are not any dead stock burial sites located in the watershed. Farmers can either pay a service fee to have their stock discarded at an approved disposal site or they can sell their dead animals to Maritime Pet Foods. Both are located outside of the watershed. They can also dispose of the carcasses on their own land (which is the most likely scenario).

3.8 Erosion Control Projects

There are six erosion control projects located within the Brudenell - Cardigan Rivers Watershed Complex (Map 11L/2). Of these, five are tile drainage projects and one is a grassed waterway (Pharo, 1988). Tile drainage projects have enabled farmers to increase the productivity of low class agricultural lands (DeHaan, 1989).

4.0 FISH AND WILDLIFE RESOURCES

Fish and wildlife resources are important to both residents and tourists alike on Prince Edward Island in terms of the recreational and economic benefits they provide. Fish and wildlife on P.E.I. are dependent upon surface water resources either for primary habitat or as a source of drinking water.

4.1 Angling Areas

There are numerous angling sites located along the river banks traversing the watershed including six listed in Angling on Prince Edward Island (P.E.I. Department of Tourism and Parks, 1988), (Map 11L/2). The entire watershed is described as good for fishing (Stewart, 1988).

4.2 Hunting Areas

The entire Brudenell - Cardigan Rivers Watershed Complex is an excellent area for hunting waterfowl (Maps 11L/1, 11L/2, 11L/7 and 11L/8). The fields of food crops, especially grain, provide an abundant food supply for waterfowl during their spring and fall migrations. Woodlots and hedgerows separating agricultural fields provide habitat for such upland game as Hungarian partridge, snowshoe hare, ruffed grouse, pheasant, snipe and woodcock. Since wildlife is known to be migratory in response to habitat requirements and food availability, their boundaries are not static from year-to-year.

4.3 Trapping Areas

As with hunting areas, the trapping areas located within the Brudenell - Cardigan Rivers Watershed Complex (Maps 11L/1 and 11L/2) do not have consistent boundaries from year-to-year (Stewart, 1988). They are dependent both upon the movement of animals and the preferences of trappers. Species trapped include beaver, fox, mink, muskrat and snowshoe hare. Trapping pressure within the area is dependent upon the market conditions for furs.

4.4 Beaver Activity Areas

Beaver dams in streams and rivers result in the creation of flowages. These new areas provide habitat for waterfowl and furbearing mammals such as mink and muskrat. The effects of beaver dams and the resulting flowages can also be viewed negatively as they often block the passage of trout, salmon and other finfish to essential spawning and feeding areas.

There are nine known active beaver areas located within the Brudenell River subwatershed and none in the Cardigan River subwatershed (Dibblee, 1989).

5.0 RECREATIONAL ACTIVITIES

Surface water and some recreational activities go hand-in-hand (swimming and boating). Other activities (hiking and skiing) are often enjoyed in close proximity to streams and rivers. Similarly, major recreational facilities (provincial parks and campgrounds) are generally situated adjacent to Island surface water resources.

5.1 Provincial Parks / Private Campgrounds

There is one provincial park located within the Brudenell - Cardigan Rivers Watershed Complex. Brudenell River Provincial Park, located on the banks of the Brudenell River at Roseneath (Map 11L/2), offers picnic, day-use, camping,

boating, golfing and horseback trail rides.

In addition, five cottage rental businesses and four bed and breakfast operations are located within the watershed. Most offer an assortment of recreational activities such as boating, swimming and clam digging (P.E.I. Department of Tourism and Parks, 1989).

5.2 Swimming Areas

Generally, people will swim where they desire. In P.E.I., many of the best swimming areas are coastal. Therefore, most of the Brudenell - Cardigan Rivers Watershed Complex is excluded.

The only organized swimming activities on the Island occur through the Canadian Red Cross Society which does not conduct swimming events in the Brudenell - Cardigan Rivers Watershed Complex (MacLean, 1989). Ponds, areas near bridges and the wider sections of the rivers would be the areas most used for recreational swimming.

5.3 Boating / Canoeing Areas

The Prince Edward Island Recreational Canoeing Association is able to provide information on various canoeing routes throughout the province but does not offer any organized trips (P.E.I. Department of Tourism and Parks, n.d.). The Brudenell River is suitable for canoeing with access to the river available at Brudenell Island. The described route for canoeists runs from Brudenell Island to the railway bridge, which is located below Dewars Pond, and then back to the entry point (Map 11L/2). Canoeing on the Cardigan River can be undertaken from the launching area at the Route #311 Bridge crossing the river (Map 11L/2).

Most larger boats enter the rivers via public launching ramps located in Georgetown and Montague. Deeper draft sailing boats are very much limited in their access to the shallower sections of the rivers. Boat, boardsailer and canoe rentals are available at Brudenell River Provincial Park.

5.4 Hiking / Cross-Country Skiing / Snowshoeing

For the nature-buff or recreational enthusiast, a good method in which to see an area is on foot, either by hiking, cross-country skiing or snowshoeing. In this way, people can go at their own pace, perhaps photographing what catches their eye or just enjoying the great outdoors.

There are no organized hiking or cross-country trails within the Brudenell - Cardigan Rivers Watershed Complex although trails on private lands and rail lines can be used.

Snowshoeing may be undertaken anywhere within the watershed. However, the areas utilized for hiking and/or cross-country skiing most likely have the highest use for snowshoers as well.

5.5 Snowmobiling / Horseback Riding

There are no snowmobiling clubs located within the watershed and therefore, no large organized excursions. Snowmobilers are often observed riding in smaller numbers through fields and along woods' and seasonal roads.

There is one horseback riding operation located within the Brudenell - Cardigan Rivers Watershed Complex. It is located within Brudenell River Provincial Park. There have also been horses noted in several pastures and it is, therefore, assumed that some private trails exist as well.

5.6 Unplowed (Seasonal / Scenic Heritage) Roads

Many local and unpaved roads in the watershed (Maps 11L/1 and 11L/2) are not open for vehicular traffic during the winter months. The relative abundance of such roads provides excellent facilities for winter recreational activities such as cross-country skiing, snowshoeing and snowmobiling. Often not well travelled even during the warmer months, these roads may further supply recreational opportunities for hiking, cycling and horseback riding.

Various roads across the Island have been designated as Scenic Heritage Roads due to their natural and historical significance. There have not been any such designations within the Brudenell - Cardigan Rivers Watershed Complex to date (Horne et. al., 1988).

6.0 FISHERIES OPERATIONS

The fishing industry is very important to the economy of Prince Edward Island. Most Island watersheds have an estuarial component thereby supporting a fishery to some extent. All finfish and shellfish harvesting can be placed into three broad categories, namely; licensed commercial, non-licensed commercial/recreational and finfish aquaculture.

6.1 Licensed Commercial

Some sections of the Brudenell River and Cardigan River estuaries are classed as public fishing domain. There are not any suspended or ground shellfish leases and any fisherman can remove shellfish in season. Other areas are specific leased areas or zones and can be fished only by the lease owner. Fourteen mussel leases and two finfish leases are located within the watershed (Small, 1988).

The primary public oyster and quahog harvesting areas are indicated on Maps 11L/1 and 11L/2. Soft-shelled clams are also harvested in the Brudenell River on both a commercial and non-commercial basis.

The watershed is open to eel netting annually from August 15 to November 30. The entire system is open to eel spearing on a year round basis. Silverside are harvested only at the Cardigan Bridge (Gallant, 1988).

The value of the clams and eels taken from the watershed was nearly twenty-four thousand dollars in 1987 (Figure 6.1).

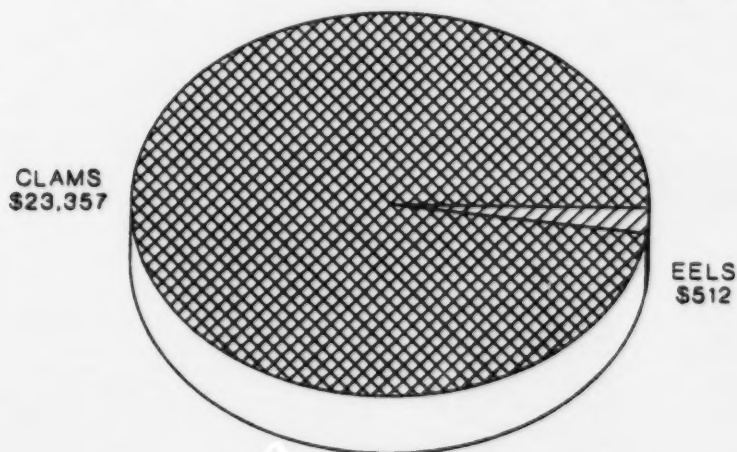


Figure 6.1 Brudenell — Cardigans Rivers Watershed Complex Fish/Shellfish Landings (1987)

Shellfish concentrations within the Brudenell River and Cardigan River estuaries have been identified by Department of Fisheries and Oceans (D.F.O.) staff (Maps 11L/1 and 11L/2).

6.2 Non-Licensed Commercial / Recreational

Despite the closure of some sections of the Brudenell river estuary of the Brudenell River due to bacterial contamination, significant non-licensed commercial and recreational finfish and shellfish harvests are carried out in the area. However, any shellfish which are removed from the contaminated areas must be transferred to unpolluted areas for flushing (a period of three to four weeks). People who harvest shellfish from contaminated areas must first obtain a conditional permit from the Department of Fisheries and Oceans.

Trout, salmon, smelt and mackerel are harvested on a recreational basis at the mouths of the Brudenell and Cardigan Rivers. Quahogs, clams and mussels are harvested from public areas. Bar clams are also harvested at the mouth of the Cardigan River.

6.3 Aquaculture Operations

The Department of Fisheries and Oceans has issued two conditional finfish aquaculture permits for the watershed. One is located in the estuarial portion of the Brudenell River near Georgetown while the other is situated at the mouth of the Seal River, a tributary of the Cardigan River (Map 11L/2).

There are also two land-based finfish aquaculture operations within the watershed. The Cardigan Fish Culture Station, a D.F.O.-operated facility located near the Village of Cardigan, produces Atlantic salmon, rainbow and brook trout for the purpose of stocking P.E.I. ponds and rivers. Water is sourced at a rate of 4500 litres per minute from the Cardigan River and wells (Murphy, L., 1989).

D.F.O. biologists are conducting research at the Station related to the increased survival rates of salmon smolt; reducing costs of production; and expanding their smolt producing capabilities through the use of several spring-fed ponds across the Island.

The Georgetown aquaculture facility, which raises rainbow trout for New England markets, is an indoor operation which has recently changed ownership. Water required for operation is sourced from several high volume wells which were dug specifically for the plant.

6.4 Closure Areas

Shellfish (mussel) poisoning triggered by domoic acid in 1987 was traced to the Cardigan River. Several rivers across Prince Edward Island which were used for the commercial production of shellfish were subsequently closed. Today, all shellfish producing areas on P.E.I. are closely monitored for the toxin. The Georgetown Harbor section of the Brudenell River between Poxy Island and the Georgetown Wharf is closed to shellfish harvesting due to bacterial contamination (Map 11L/2).

7.0 INDUSTRIAL OPERATIONS

Many of the industrial operations on Prince Edward Island have an effect on surface water resources in one way or another. Some discharge both treated and untreated wastes directly into streams and rivers, while others allow for the seepage of pollutants to surface or groundwater sources. Some industrial operations require a surface water source for use in their processes.

7.1 Stormwater Drainage

All municipalities contained within the Brudenell - Cardigan Rivers Watershed Complex are relatively small and do not contain extensive stormwater drainage systems. Georgetown has a small sytem which drains through four collection inlets and disharges untreated into Georgetown Harbor (Henry, 1989).

7.2 Sewage Lagoons

Two sewage treatment lagoons within the Brudenell - Cardigan Rivers Watershed Complex are located on the Brudenell River at Brudenell River Provincial Park and Georgetown (Map 11L/2). The effluent entering the park's lagoon is not monitored but the Georgetown facility handles 360 Single Family Equivalent Units representing an annual flow of one hundred and twenty-three thousand cubic metres (123,000 m³). The discharge from both of the lagoons is piped directly into the Brudenell River (Hogan, 1988).

7.3 Abandoned, Active and Unapproved Dump Sites

During 1982-83, the P.E.I. Department of Community and Cultural Affairs, in conjunction with Environment Canada, performed a study in which abandoned, active and unapproved waste disposal sites on Prince Edward Island were located and inspected (Water Resources Section, 1983). Of prime concern during the inventory was the potential for groundwater contamination. A total of sixteen sites were identified within the Brudenell - Cardigan Rivers Watershed Complex (Maps 11L/1 and 11L/2).

As part of the inventory a scoring system was used to rate and prioritize (Priority I, II and III) each site on the basis of actual and potential environmental effects. Priority I sites were rated as being most hazardous to the environment; Priority II dumps were less hazardous; while Priority III sites were generally very small discriminate sites which were not considered to be environmentally hazardous. Evaluation of the abandoned dumps revealed two Priority I, three Priority II, eight Priority III and three unclassified sites.

The Air and Solid Wastes Branch of the P.E.I. Department of the Environment has identified six dumps within the watershed which are currently active. Three are approved sites while three are not actively operated by the Department of the Environment (Curley, 1989).

There is no established program for hazardous waste disposal on Prince Edward Island (Curley, 1988). However, the Air and Solid Wastes Branch cooperates with their Federal counterparts in controlling toxic waste disposal. For example, asbestos, which has been removed from buildings is

double-bagged and dumped at landfill sites. Agricultural pesticides are sometimes left at dumpsites illegally. Since it is difficult to regulate such practices, remnant chemicals could become a potential hazard to both surface and groundwater resources.

The only other major form of toxic wastes on P.E.I. are polychlorinated biphenols (PCB's). As these compounds do not break down under normal conditions they must be stored until they can be transported to a proper disposal site (located off-Island). The Prince Edward Island Development Agency has twenty four hundred (2400) litres of PCB's stored in Georgetown (Guardian - Patriot, 1988).

7.4 Excavation Pits

Scattered throughout Prince Edward Island are numerous excavation pits used for the private and commercial removal of sandstone, and to lesser amounts, gravel and sand. A total of three registered excavation pits (Map 11L/2) are active in the watershed. Records are not kept concerning the quantity of material removed from the individual pits and there are other pits for which permits have not been obtained. Records are also not maintained concerning the number of non-operational or abandoned pits (Murphy, C., 1988).

7.5 Salt / Sand Storage Locations

The P.E.I. Department of Transportation and Public Works maintains a number of salt/sand storage areas across the Island. At these temporary sites, the salt and sand is stored directly on the ground with little or no site preparation. Often, the locations of these secondary sites change thereby yielding both abandoned and active sites. Two active sites, both of which are located within the Cardigan River subwatershed (Woodville Mills and Cardigan), have been identified (Map 11L/2).

7.6 Snow Disposal Sites

Snow removal is generally not a problem due to the relatively small size of the communities located in the Brudenell - Cardigan Rivers Watershed Complex. Snow is either pushed into roadside ditches or is plowed into fields (Goetell, 1989). However, there are occasions during the winter in the communities of Georgetown and Cardigan when the snow is deposited onto the Federal Government wharves (Map 11L/2) where it remains until it melts (Wilson, 1989). This practice may affect the quality of water as the contaminants picked up with the snow enter the watercourses.

7.7 Additional Industrial Activities

The Brudenell - Cardigan Rivers Watershed Complex relies

on three main industries; fisheries, agriculture and tourism. There are also a few light industrial operations located within the watershed but these do not have a significant effect on the quality of surface waters.

7.7.1 Georgetown Shipyards Inc.

This provincially-owned Crown Corporation operates a ship fabrication and repair facility and a marine slip beside Georgetown Harbour (Map 11L/2). Because of the large volume of toxic materials used in the construction, repair and maintenance of ships and the necessary proximity of the industry to the water, some escape of these materials into the water is inevitable.

7.7.2 Marine and Machine Shops

A number of small ship maintenance, repair and machine shops are located within the watershed. These operations have the potential to accidentally discharge petroleum products and other chemicals into the Cardigan River.

7.7.3 Sawmills

There are also several sawmills which are operated as small businesses. Some of the mills are mobile (frequently powered by tractors) and will process wood at the lot, while others are fixed and are powered by water, generators or electricity. There is also a large mill located near Georgetown (Map 11L/2). Sawmill waste can increase the biological oxygen demand of waterways and, in some cases, cause increases in their acidity (Godfrey, 1989).

8.0 ALTERATIONS OF NATURAL FEATURES OF WATERWAYS

Individuals or groups wishing to alter a water system directly or indirectly to improve its recreational potential, to provide a reservoir for agricultural purposes or fire protection, or to construct a stream crossing, must seek approval from the P.E.I. Department of Community and Cultural Affairs (Environmental Protection Act, Sections 10 and 11).

8.1 Application Process and Requirements

Alteration applications are subject to government control under the P.E.I. Environmental Protection Act (Section 10) and the Canada Fisheries Act (Chapter F-14, Section 20). Before requests are given final approval by the Head of the Watercourse Alteration Advisory Committee, they are reviewed by several Federal/Provincial Government and private agencies. Once approval is granted, inspections are carried out to ensure that the recommendations of the Committee are being followed.

Application considerations include the following criteria: the well-being of the fisheries resource; possible changes in water quality; stream-side cutting leading to loss of essential food and cover for wildlife; and the effects of the alteration on other types of wildlife.

Types of alterations include; installation of dams and/or fishways, bypass pond construction, roadway culvert installation, rock gabion installation and the infilling of marshes. Infilling applications, most often, are rejected since the practice results in a loss of wildlife habitat.

Since P.E.I. soils are highly susceptible to erosion, proponents who alter waterways must undertake erosion control measures throughout the construction process.

8.2 Dam Inspections

There are twenty (20) dams located within the Brudenell - Cardigan Rivers Watershed Complex (Map 11L/2). Fourteen are contained within the Brudenell River subwatershed including eight on the golf course at Brudenell River Provincial Park which were not inspected. The remaining six dams are located within the Cardigan River subwatershed.

Some of the dams were found to constitute a complete barrier for fish passage due to a variety of factors; including insufficient water depths within road-stream structures, debris in the waterway, lack of a fishway where needed and blockage by beaver dams (refer to Section 11.3). Descriptions of dams located within the watershed are contained in Appendix A.

8.3 Fishways

On Prince Edward Island, whenever an alteration is made to a waterway, the continued passage of fish must be ensured [Canada Fisheries Act, Chapter F-14, Section 20, (1)]. This involves, in some cases, the construction of a fishway. Various fishway designs are available with the type constructed dependent upon the species of fish to be passed and the water level fluctuations within the impoundment.

One fishway was identified within the watershed. The five step pool-and-weir structure, located on the Cardigan River at Fitzpatrick's Pond (Map 11L/2), was determined to be in good condition.

8.4 Road - Stream Intersections

The P.E.I. Department of Transportation and Public Works maintains a reference map which provides an up-to-date record of all major highway structures, that is, those over 1.2 metres in diameter, within the province. The Brudenell - Cardigan Rivers Watershed Complex contains thirty-one (31)

such structures (Maps 11L/1 and 11L/2).

The Watershed Inventory Project also identified thirty-two (32) additional road - stream intersections which, due to their smaller size, are not kept on file at the Department of Transportation and Public Works (Maps 11L/1 and 11L/2). These areas were located via 1:50,000 N.T.S. maps but not all were field checked due to time and manpower constraints.

8.5 Rail - Stream Intersections

Earlier this century, railroads on Prince Edward Island were a vital component in the transportation of goods across the Island. However, due to increased rail costs and more efficient trucking methods, its importance is rapidly decreasing. Therefore, all lines across the province were abandoned effective January 1990.

Once the lines are abandoned, CN Real Estate will contract out for the removal of the ties and rails. Crossing structures are not usually removed since they are often more useful if left in place.

There are three major railway - stream intersections (Map 11L/2). After abandonment, the cessation of regular maintenance of the crossings could present problems for fish passage.

9.0 WETLANDS

Wetlands include salt marshes, intertidal flats, bogs, freshwater marshes, swamps and ponds. They are important for many reasons (Canadian Wildlife Service, n.d.) :

1. as wildlife habitat;
2. act as natural filters;
3. bind pollutants thereby slowing the eutrophication process;
4. reduce flooding by acting as reservoirs; and
5. recharge the groundwater supplies.

During 1983 - 84 wetlands over 0.25 hectares on Prince Edward Island were inventoried. The objective of the program was to provide information on the classification, size, distribution and wildlife value of P.E.I. wetlands.

9.1 Freshwater Wetlands

All freshwater wetlands within Prince Edward Island were identified during the inventory and were given a wildlife value based on a wide array of parameters. The wetlands received a score between 36 and 108 with a score of 60+ indicating generally more productive areas.

There were a total of twenty (20) freshwater wetlands with a score of 60+ delineated within the Brudenell - Cardigan Rivers Watershed Complex (Maps 11L/1 and 11L/2). Eleven are located within the Brudenell River subwatershed while nine are in the Cardigan River subwatershed (Canadian Wildlife Service, n.d.).

9.2 Coastal Wetlands

Coastal wetlands were classified and scored as coastal units during the wetland inventory. The coastal unit score was calculated using the total of the scores from six component types of wetlands along with five additional factors. Added to that was a value for the disturbance status of the unit. The total coastal unit score indicated its productivity and provides a measure of its importance to wildlife. The coastal unit scores ranged from 10 to 1500 points and were indicated as the sum of all wetlands within the unit.

Of the fifteen coastal wetlands, eleven are found within the Cardigan River subwatershed and four are in the Brudenell River subwatershed (Map 11L/2), (Canadian Wildlife Service, n.d.).

9.3 Ducks Unlimited Canada Management Sites

Ducks Unlimited Canada is active on Prince Edward Island in the enhancement and management of wildlife habitat. Several types of management techniques are employed for this purpose. Installation of water control devices such as drop inlets and stoplog control structures allow for the creation of ponds and the regulation of water levels in order to maintain optimal habitat conditions. Fishways are usually installed with the water level control structures in order to allow for the continued passage of fish into and out of the impoundment.

There are two active Ducks Unlimited sites in the watershed (Table 9.1), (Map 11L/2).

Table 9.1 Ducks Unlimited Canada Management Sites Located Within The Brudenell - Cardigan Rivers Watershed Complex

PROJECT	AREA (ha)	SHORELINE (km)	YEAR COMPLETED
Cardigan	24.29	4.8	1975
St. Georges	9.31	1.6	1986

10.0 ADDITIONAL ACTIVITIES WITHIN THE BRUDENELL - CARDIGAN RIVERS WATERSHED COMPLEX

10.1 Hydrometric Stations / Water Chemistry Data

The first streamflow data collected in Prince Edward Island was from the Dunk River at Rogers Mill between 1919 and 1935. Currently, there are two stations on P.E.I. which have been in operation since 1961.

There are three hydrometric stations located in the Brudenell - Cardigan Rivers Watershed Complex (Map 11L/2). NAQUADAT No. 01CE003, which was deactivated in 1979, and NAQUADAT No. 01CE004 collect data from the Brudenell River near Brudenell while NAQUADAT No. 01CE006 has been collecting data from the Cardigan River since 1988. Land use characteristics for the basins draining to the Brudenell River stations have been determined by Inland Waters Directorate, Environment Canada, Dartmouth, Nova Scotia and appear in Table 10.1. Physiographic data is unavailable for the Cardigan River station.

Table 10.1 Land Use Characteristics of Hydrometric Stations Located Within The Brudenell - Cardigan Rivers Watershed Complex

Station Number	Drainage Area (km ²)	Forest Area (km ²)	Cleared Area (km ²)	Swamp Area (km ²)	Pond Area (km ²)	Basin Perimeter (km)	Total Length of Stream (km)	Stream Gradient (%)	Period of Record
01CE003	36.30	14.20	21.10	0.78	0.148	25.70	32.80	0.34	1965-1979
01CE004*	33.80	13.60	19.30	0.73	0.125	24.20	29.80	0.35	1979-PRESENT
01CE006*	21.40	-	-	-	-	-	-	-	1988-PRESENT

* ACTIVE

In addition, the Water Quality Branch, Inland Waters Directorate, Environment Canada, Moncton, New Brunswick also maintains somewhat limited data associated with the following studies:

- P.E.I. Groundwater Study (May 1972 - September 1973);
- P.E.I. Surface Water Quality Survey (July 1972);
- Water Quality Board National Water Quality Monitoring (April 1974 - March 1978); and the
- Toxic Chemical Survey (1985).

Parameters monitored included the following: major ions, physical parameters, nutrients, metals and toxic substances.

11.0 ACTIVITIES AFFECTING SURFACE WATER RESOURCES WITHIN THE BRUDENELL - CARDIGAN RIVERS WATERSHED COMPLEX

Many of the problems affecting surface water resources within the Brudenell - Cardigan Rivers Watershed Complex occur as a result of the high erodibility of Island soils. Soil erosion is accelerated by poor agricultural, forestry and road maintenance and construction practices. The problems affecting surface water resources on P.E.I. can be placed into three general categories: sedimentation (siltation) sources, pollution point sources and instream obstructions.

11.1 Sedimentation (Siltation) Sources

The entry of soil into surface waterways is described by the Watershed Inventory Project as a sedimentation (siltation) source. Autumn tillage, particularly plowing with the slope and cultivation excessively close to the streams' edge, often results in extensive landwash and siltation of the Island's waterways. Improper forestry operations, such as clearcutting on steep slopes and removal of greenbelts along streams and rivers also provides for sedimentation of streams and rivers.

One of the major sources of siltation to Island waterways is caused by the construction and maintenance of P.E.I. roads. Many roads on the Island are unpaved which presents numerous potential sources of sedimentation. Improper grading of these roads, in particular, leaving a ridge of clay and sand at either edge allows runoff water to form channels causing erosion to the road surface. Water usually flows alongside these ridges until it "breaks" through, usually at a road-stream intersection. This practice of grading also renders ditches, if present, useless.

Silt-loading of Island streams and rivers does not usually affect the waterway at the point of entry but its effects are impacted further downstream. Soil particles are carried by currents and deposited in the stream covering essential finfish spawning areas. Shellfish beds within the estuaries are adversely affected in that they are smothered by silt that originated upstream.

11.1.1 Byrnes Creek

The unpaved road crossing this tributary of the Cardigan River (Map 11L/2) lacks ditching on either side. Dirt is banked on both sides of the road causing channelling on the road surface. The runoff eventually breaks through at the Byrnes Creek intersection and enters the waterway.

11.1.2 Cardigan

This road-stream intersection is steeply sloped on the downstream side (Map 11L/2). Thus, sedimentation is occurring to this unnamed tributary of the Cardigan River.

11.2 Pollution Point Sources

The entry of non-natural substances into a surface waterway is known as a pollution point source. For example, fertilizer and manure runoff into surface waterways results in bacterial and chemical contamination of the system. As well, inadequately or improperly treated human sewage, stormwater drainage and the discharge of industrial effluents also contribute to the deterioration of P.E.I.'s surface water quality.

The most recent examples of pollution point sources on the Island have been the entry of petroleum products, specifically gasoline, into streams, rivers and groundwater aquifers. This has resulted from either transportation accidents or leakage from underground storage tanks.

In many cases, the result of these pollution point sources is the eutrophication of the aquatic system. As is the case with siltation, the effects of many pollution point sources are felt in downstream areas. This can, for example, result in the closure of shellfish harvesting areas.

11.2.1 Cardigan

Runoff from the manure storage area of a piggery is making its way to a spring which feeds a tributary of the Cardigan River (Map 11L/2). The P.E.I. Department of the Environment has overseen recent improvements but further work to stem the flow of manure is required.

11.2.2 New Perth I

Cattle have access to an unnamed tributary of the Brudenell River, which is located upstream of Munns Pond (Map 11L/2), thereby causing bacterial contamination and sedimentation to the river.

11.2.3 New Perth II

Stock watering is occurring to the upper reaches of the Brudenell River near New Perth (Map 11L/2). This causes both a pollution point and siltation source to the river.

11.3 Instream Obstructions

Numerous other factors also influence the quality of waterways within the Brudenell - Cardigan Rivers Watershed Complex. Fallen trees or other debris in the streams and

ivers present problems for fish passage. Improperly installed and unmaintained culverts, insufficient water flow and non-existent or inadequate dam bypass structures not only pose barriers to successful fish passage but also affect the amount of water available for use in downstream areas by other proponents.

11.3.1 Cardigan

This road-stream intersection, located on an unnamed tributary of the Cardigan River (Map 11L/2), represents a total barrier to fish passage. Insufficient water depth within the 1.0 metre corrugated steel culvert and a 0.50 metre drop to the plunge pool on the downstream end makes fish passage impossible.

11.3.2 Mitchell River

This road-stream crossing on the Mitchell River, a tributary of the Cardigan River (Map 11L/2), presents a partial barrier to fish passage during periods of low water flow.

11.3.3 MacKenzies Pond

A beaver dam creates a complete barrier to fish passage at MacKenzies Pond. The pond is located on the Mitchell River (Map 11L/2), a tributary of the Cardigan River.

11.3.4 Fitzpatricks Pond

This road-stream crossing located on the Seal River (Map 11L/2), a tributary of the Cardigan River, presents a barrier to fish passage during periods of low water flow.

11.3.5 Georgetown Royalty I

The channel to a bypass pond, which is located on an unnamed tributary of the Cardigan River (Map 11L/2), is shallow and creates a barrier to fish passage.

11.3.6 Georgetown Royalty II

A drop inlet on an unnamed pond, which is located on an unnamed tributary of the Cardigan River (Map 11L/2), prohibits fish from reaching upstream locations.

11.3.7 Mellishs Pond

The bypass channel for this pond, located on the Brudenell River (Map 11L/2), is clogged with debris and represents a barrier to fish passage during periods of low water flows.

11.3.8 Munns Pond

A drop inlet water control structure on Munns Pond (Map 11L/2), which is located on the Brudenell River, does not allow for fish passage.

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APPENDIX

BRUDENELL RIVER DAM INSPECTIONSNAMEUTM LOCATIONDewar's Pond

527100-5116100

This dam is breached and should not present problems for fish passage.

Munn's Pond

526400-5116900

A drop inlet water control structure does not allow for fish passage into and out of this impoundment from downstream.

Mellish's Pond

524800-5115500

The bypass channel is clogged with natural debris and may present a barrier to fish passage.

Martin's Pond

523700-5115500

The bypass channel from this pond is okay for fish passage.

MacNeill's Pond

522800-5116200

The bypass channel from this pond is okay for fish passage.

William's Lake

5121600-5117400

There is no visible outlet from this lake, thereby constituting a complete barrier to fish passage.

*The following UTM locations are for dams located on Brudenell River Provincial Park's Golf Course and were not inspected:

530100-5116700

530600-5116600

530700-5116800

530700-5116900

531100-5116900

531100-5116800

531100-5116700

531200-5116600

CARDIGAN RIVER DAM INSPECTIONS

<u>NAME</u>	<u>UTM LOCATION</u>
<u>Fitzpatrick's Pond I</u> 0.20 meter high barrier over a distance of 0.90 meters. Plunge pool is 0.33 meters deep.	537300-5120700
<u>Fitzpatrick's Pond II</u> Box culvert constructed of creosote timbers is a complete barrier during periods of low water flow.	537300-5120600
<u>MacKenzie's Pond</u> Beaver dam results in a complete barrier to the upper pond.	534300-5120800
<u>Georgetown Royalty I</u> Shallow by-pass channel is shallow and rocky. It is a complete barrier during low water flow.	536300-5116200
<u>Georgetown Royalty II</u> Drop inlet water control structure does not allow for fish passage thereby creating a complete barrier.	536000-5116000
<u>Woodville Mills</u> 5-step pool and weir fishway.	538200-5121900